

# Inhomogeneous extra space as a tool for the top-down approach

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## Abstract

© 2018 Sergey G. Rubin. The top-down approach for the 6-dimensional space has been elaborated. The connection between the cosmological constant and the extra space metric has been obtained. The metric can be found with the necessary accuracy. It is shown that descent from high energies to the low ones leads to the quantum corrections which influence weakly the metric of extra space.

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## References

- [1] R. H. Brandenberger, A. Nayeri, S. P. Patil, and C. Vafa, "String gas cosmology and structure formation," *International Journal of Modern Physics A*, vol. 22, no. 21, pp. 3621-3642, 2007.
- [2] M. Tegmark, A. Aguirre, M. J. Rees, and F. Wilczek, "Dimensionless constants, cosmology, and other dark matters," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 73, no. 2, Article ID 023505, 2006.
- [3] A. Loeb, "An observational test for the anthropic origin of the cosmological constant," *Journal of Cosmology and Astroparticle Physics*, no. 5, article no. 009, 2006.
- [4] A. Ashoorioon, K. Dimopoulos, M. M. Sheikh-Jabbari, and G. Shiu, "Reconciliation of high energy scale models of inflation with Planck," *Journal of Cosmology and Astroparticle Physics*, vol. 2014, no. 2, article no. 025, 2014.
- [5] A. Krause, "A small cosmological constant and backreaction of non-finetuned parameters," *Journal of High Energy Physics*, vol. 09, article 016, 2003.
- [6] A. Linde, "Hybrid inflation," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 49, no. 2, pp. 748-754, 1994.
- [7] O. L. Trinhammer, "On the electron to proton mass ratio and the proton structure," *EPL (Europhysics Letters)*, vol. 102, no. 4, Article ID 42002, 2013.
- [8] A. Ibarra, E. Molinaro, and S. T. Petcov, "Low energy signatures of the TeV scale seesaw mechanism," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 84, Article ID 013005, 2011.
- [9] S. G. Rubin, "Scalar field localization on deformed extra space," *The European Physical Journal C*, vol. 75, no. 7, 2015.
- [10] K. Bronnikov, R. Budaev, A. Grobov, A. Dmitriev, and S. G. Rubin, "Inhomogeneous compact extra dimensions," *Journal of Cosmology and Astroparticle Physics*, vol. 2017, no. 10, pp. 001-001, 2017.
- [11] M. E. Peskin and D. V. Schroeder, *An Introduction to Quantum Field Theory*, Addison-Wesley, Reading, Mass, USA, 1995.
- [12] C. P. Burgess, "The Cosmological Constant Problem: Why its hard to get Dark Energy from Micro-physics," in *Proceedings of the 100th Les Houches Summer School: Post-Planck Cosmology*, pp. 149-197, LesHouches, France, July 2013.
- [13] M. P. Hertzberg and A. Masoumi, "Can compactifications solve the cosmological constant problem?" *Journal of Cosmology and Astroparticle Physics*, vol. 2016, no. 6, article no. 053, 2016.
- [14] A. Babić, B. Guberina, R. Horvat, and H. Stefancić, "Renormalization-group running of the cosmological constant and its implication for the Higgs boson mass in the standard model," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 65, no. 8, 2002.

- [15] E. Dudas, C. Papineau, and V. Rubakov, "Flowing to four dimensions," *Journal of High Energy Physics*, no. 3, pp. 5057-5073, 2006.
- [16] A. A. Starobinsky, "A new type of isotropic cosmological models without singularity," *Physics Letters B*, vol. 91, no. 1, pp. 99-102, 1980.
- [17] A. De Felice and S. J. Tsujikawa, "f(R) theories," *Living Reviews in Relativity*, vol. 13, p. 3, 2010.
- [18] K. Bamba, A. N. Makarenko, A. N. Myagky, S. Nojiri, and S. D. Odintsov, "Bounce cosmology from F(R) gravity and F(R) bigravity," *Journal of Cosmology and Astroparticle Physics*, vol. 2014, no. 1, article no. 008, 2014.
- [19] L. M. Sokolowski, "Metric gravity theories and cosmology. II. Stability of a ground state in (f) theories," *Classical and Quantum Gravity*, vol. 24, no. 14, pp. 3713-3734, 2007.
- [20] U. Günther, A. Zhuk, V. B. Bezerra, and C. Romero, "AdS and stabilized extra dimensions in multi-dimensional gravitational models with nonlinear scalar curvature terms -1 and 4," *Classical and Quantum Gravity*, vol. 22, no. 16, pp. 3135-3167, 2005.
- [21] K. A. Bronnikov and S. G. Rubin, "Self-stabilization of extra dimensions," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 73, no. 12, Article ID 124019, 2006.
- [22] R. B. Abbott, S. M. Barr, and S. D. Ellis, "Kaluza-Klein cosmologies and inflation," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 30, no. 4, pp. 720-727, 1984.
- [23] M. Chaichian and A. B. Kobakhidze, "Mass hierarchy and localization of gravity in extra time," *Physics Letters B*, vol. 488, no. 2, pp. 117-122, 2000.
- [24] L. Randall and R. Sundrum, "An alternative to compactification," *Physical Review Letters*, vol. 83, no. 23, pp. 4690-4693, 1999.
- [25] A. R. Brown, A. Dahlen, and A. Masoumi, "Compactifying de Sitter space naturally selects a small cosmological constant," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 90, no. 12, Article ID 124048, 2014.
- [26] V. A. Gani, A. E. Dmitriev, and S. G. Rubin, "Deformed compact extra space as dark matter candidate," *International Journal of Modern Physics D*, vol. 24, no. 13, Article ID 1545001, 2015.
- [27] S. G. Rubin, "The role of initial conditions in the universe formation," *Gravitation & Cosmology*, vol. 21, no. 2, pp. 143-151, 2015.
- [28] A. A. Kirillov, A. A. Korotkevich, and S. G. Rubin, "Emergence of symmetries," *Physics Letters B*, vol. 718, no. 2, pp. 237-240, 2012.
- [29] S. Weinberg, "The cosmological constant problem," *Reviews of Modern Physics*, vol. 61, no. 1, pp. 1-23, 1989.
- [30] J. Martin, "Everything you always wanted to know about the cosmological constant problem (but were afraid to ask)," *Comptes Rendus Physique*, vol. 13, no. 6-7, pp. 566-665, 2012.
- [31] Ya. B. Zeldovich, "Cosmological constant and elementary particles," *JETP Letters*, vol. 6, article 316, 1967.
- [32] S. Nasri, P. J. Silva, G. D. Starkman, and M. Trodden, "Radion stabilization in compact hyperbolic extra dimensions," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 66, no. 4, Article ID 045029, 2002.
- [33] S. M. Carroll, J. Geddes, M. B. Hoffman, and R. M. Wald, "Classical stabilization of homogeneous extra dimensions," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 66, no. 2, article 024036, 2002.
- [34] B. Greene and J. Levin, "Dark energy and stabilization of extra dimensions," *Journal of High Energy Physics*, vol. 2007, no. 11, article no. 096, 2007.
- [35] B. P. Abbott, R. Abbott, and T. D. Abbott, "Observation of gravitational waves from a binary black hole merger," *Physical Review Letters*, vol. 116, no. 6, article 061102, 2016.
- [36] H. Yu, B.-M. Gu, F. P. Huang, Y.-Q. Wang, X.-H. Meng, and Y.-X. Liu, "Probing extra dimension through gravitational wave observations of compact binaries and their electromagnetic counterparts," *Journal of Cosmology and Astroparticle Physics*, vol. 2017, no. 2, article no. 039, 2017.
- [37] D. Bettoni, J. M. Ezquiaga, K. Hinterbichler, and M. Zumalacarregui, "Speed of gravitational waves and the fate of scalar-tensor gravity," *Physical Review D: Particles, Fields, Gravitation and Cosmology*, vol. 95, no. 8, Article ID 084029, 2017.
- [38] J. García-Bellido, S. Nesseris, and M. Trashorras, "Gravitational wave source counts at high redshift and in models with extra dimensions," *Journal of Cosmology and Astroparticle Physics*, vol. 2016, no. 7, article no. 021, 2016.
- [39] E. Calabrese, N. Battaglia, and D. N. Spergel, "Testing gravity with gravitational wave source counts," *Classical and Quantum Gravity*, vol. 33, no. 16, Article ID 165004, 2016.
- [40] B. Emanuele, K. Yagi, and Y. Nicolas, "Extreme Gravity Tests with Gravitational Waves from Compact Binary Coalescences: (I) Inspiral-Merger," *General Relativity and Quantum Cosmology*, <https://arxiv.org/abs/1801.03208v1>.
- [41] K. A. Bronnikov, R. V. Konoplich, and S. G. Rubin, "The diversity of universes created by pure gravity," *Classical and Quantum Gravity*, vol. 24, no. 5, pp. 1261-1277, 2007.